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**NATIONAL TRANSPORTATION SAFETY BOARD**

Office of Research and Engineering  
Materials Laboratory Division  
Washington, D.C. 20594



May 4, 2015

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**MATERIALS LABORATORY FACTUAL REPORT**

Report No. 15-047

**A. ACCIDENT INFORMATION**

Place : Mt. Pleasant, South Carolina  
Date : August 1, 2014  
Vehicle : Cessna 150M  
NTSB No. : ERA14FA387  
Investigator : Stephen Stein AS-ERA

**B. COMPONENTS EXAMINED**

Cockpit flap switch

**C. DETAILS OF THE EXAMINATION**

The cockpit switch was submitted to the Materials Laboratory for examination. The switch was submitted to determine functionality of the switch and its internal contacts including the spring back to neutral feature of the switch. The switch is shown in Figure 1. The switch was manufactured by Eaton. The part number was 90-2543-2.

When the switch was submitted to the laboratory, the switch would toggle in both directions ("keyway" or up(towards connectors 1-4) or "opposite keyway" or down (towards connectors 3-6); however the "return to neutral" function was inoperable. The switch was radiographed in each switch position to determine if the contact heads were operating as designed and to determine why the neutral position function was not working. All contact positions appeared to be working as normal. This was confirmed through continuity testing which is discussed below.

The return to neutral function operation is due to a spring located in the main body of the switch. A radiograph of the main body of the switch showed a fracture in this spring. The drawing with the corresponding radiograph of the same area is shown in Figure 2.

The functionality of the contacts in the switch was further tested by asses the continuity of the contacts in all three switch positions. Each contact was tested using a multimeter to assess whether the contact was open or closed. The results of this testing are shown in Tables 1-3. The continuity testing determined that the switch, as

wired, was functioning properly. The table provided by the manufacturer for appropriate contact position is shown below.

| CLOSED CIRCUITS RELATIVE TO LEVER POSITION |                 |                 |              |
|--|-----------------|-----------------|--------------|
| PART NO.                                   | OPPOSITE KEYWAY | CENTER POSITION | KEYWAY SIDE  |
| 90-2543                                    | 2-3 *<br>5-6 *  | 2-1<br>5-6      | 2-1*<br>4-5* |
| 90-2543-2                                  | 2-3<br>5-6      | 2-1<br>5-6      | 2-1*<br>4-5* |
| 90-2543-3                                  | 2-3 *<br>5-6 *  | 2-3<br>5-4      | 2-1*<br>4-5* |
| 90-2543-4                                  | 2-3<br>5-6      | 2-3<br>5-4      | 2-1*<br>4-5* |

\* DENOTES MOMENTARY

| Neutral switch position | Wiring position 2 | Wiring position 3 | Wiring position 4 | Wiring position 5 | Wiring position 6 |
|-------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Wiring position 1       | CLOSED            | OPEN              | OPEN              | CLOSED            | CLOSED            |
| Wiring position 2       |                   | OPEN              | OPEN              | CLOSED            | CLOSED            |
| Wiring position 3       |                   |                   | OPEN              | OPEN              | OPEN              |
| Wiring position 4       |                   |                   |                   | OPEN              | OPEN              |
| Wiring position 5       |                   |                   |                   |                   | CLOSED            |

Table 1. Contact position for flap switch in neutral position.

| <b>Keyword switch position</b> | <b>Wiring position 2</b> | <b>Wiring position 3</b> | <b>Wiring position 4</b> | <b>Wiring position 5</b> | <b>Wiring position 6</b> |
|--------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| <b>Wiring position 1</b>       | OPEN                     | OPEN                     | OPEN                     | CLOSED                   | CLOSED                   |
| <b>Wiring position 2</b>       |                          | CLOSED                   | OPEN                     | OPEN                     | OPEN                     |
| <b>Wiring position 3</b>       |                          |                          | OPEN                     | OPEN                     | OPEN                     |
| <b>Wiring position 4</b>       |                          |                          |                          | OPEN                     | OPEN                     |
| <b>Wiring position 5</b>       |                          |                          |                          |                          | CLOSED                   |

**Table 2. Contact position for flap switch in keyway position.**

| <b>Opposite switch position</b> | <b>Wiring position 2</b> | <b>Wiring position 3</b> | <b>Wiring position 4</b> | <b>Wiring position 5</b> | <b>Wiring position 6</b> |
|---------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| <b>Wiring position 1</b>        | CLOSED                   | OPEN                     | OPEN                     | OPEN                     | CLOSED                   |
| <b>Wiring position 2</b>        |                          | OPEN                     | OPEN                     | OPEN                     | CLOSED                   |
| <b>Wiring position 3</b>        |                          |                          | OPEN                     | OPEN                     | OPEN                     |
| <b>Wiring position 4</b>        |                          |                          |                          | CLOSED                   | OPEN                     |
| <b>Wiring position 5</b>        |                          |                          |                          |                          | OPEN                     |

**Table 3. Contact position for flap switch in opposite keyway position.**

Nancy B. McAtee  
Chemist

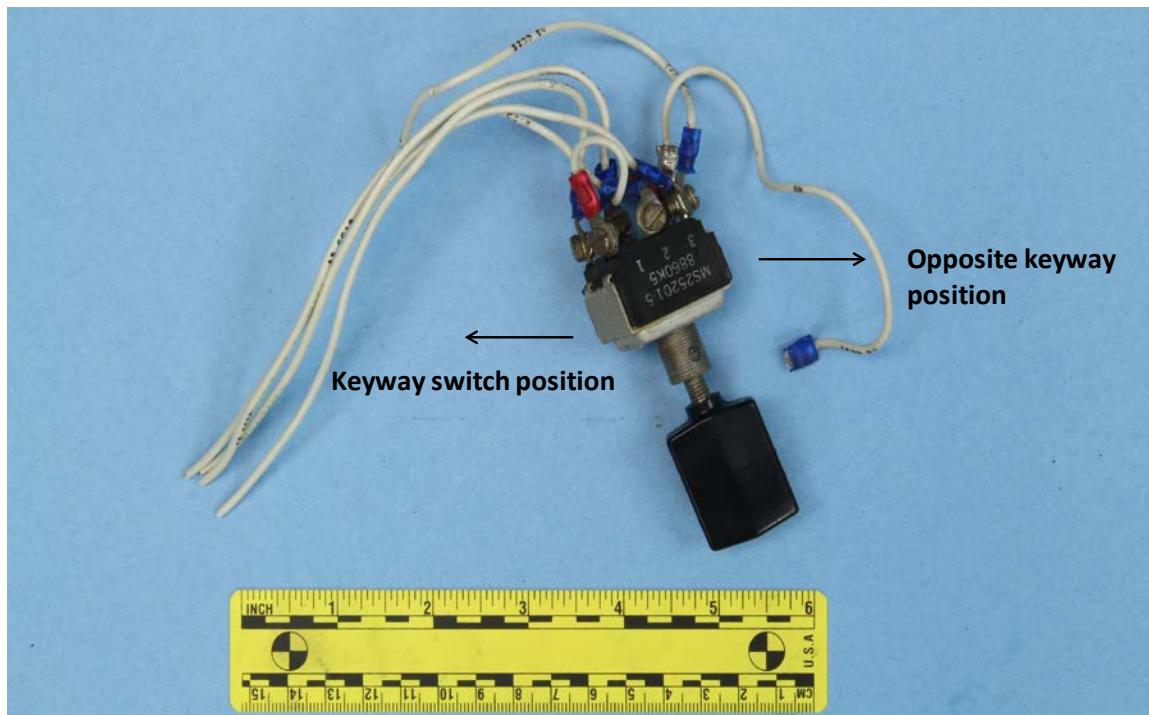


Figure 1. Cockpit flap switch with switch in neutral position.

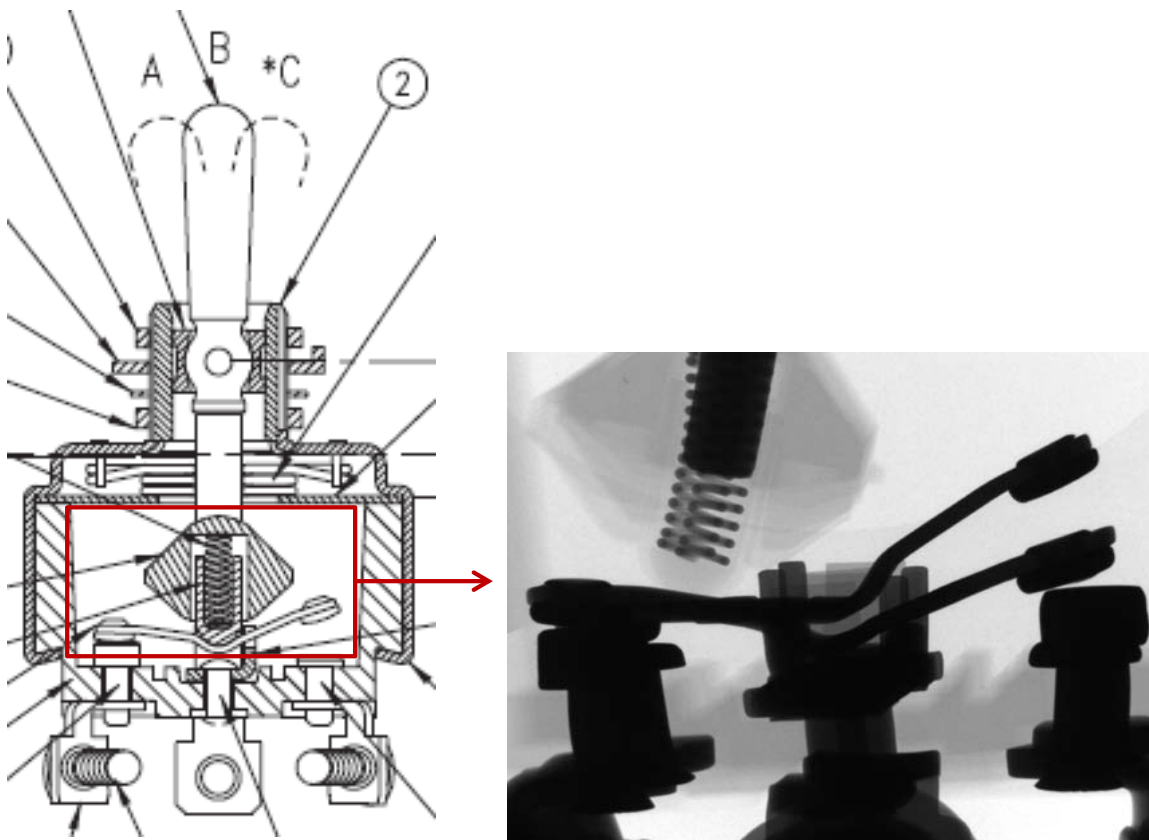


Figure 2. Drawing of switch body with radiograph of corresponding area (highlighted).